PD27-02
FEMALE SURGEONS AND SURGICAL TRAINEES TEND TO UNDER RATE TECHNICAL SKILLS ON SELF-ASSESSMENT

Brady Miller*, David Azari, Rebecca Gerber, Robert Radwin, Brian Le, Madison, WI

INTRODUCTION AND OBJECTIVES: Historically low, the proportion of female urology residents now exceeds 25% in recent years. Simulation of surgical skills is increasingly common in modern residency training and can allow for objective assessment of technical skills. The objective of this study was to identify gender differences in self-assessment of surgeons and trainees.

METHODS: Medical students, residents, attending and retired surgeons completed simple interrupted (SIS) and running subcuticular suturing (RSC) tasks. Assessment was self-rated using previously tested visual analog motion scales. Tasks were video recorded and rated using identical motion scales by blinded expert surgeons who had undergone training to standardize their assessment.

RESULTS: Female (n=17) and male (n=20) participants were equally distributed by level of training (medical students, n=10; residents, n=15; attending and retired surgeons, n=12), p=0.76. Five expert surgeons evaluated 220 30-second video segments of suturing tasks (mean 3.0 segments per task per participant). Self-assessment correlated well overall with expert rating for SIS, RSC tasks in the following domains, respectively: motion economy (p<0.001, p<0.001), motion fluidity (p=0.002, p<0.001), coordination (p=0.001, p=0.764) and tissue handling (p=0.120, p=0.001).

Mean individual difference of self-assessment and expert assessment scores (SAS-ERS) differed by gender in the domains of motion economy (-1.1±1.6 female vs -0.2±1.6 male, p=0.08 for RSC) and fluidity of motion (-1.2±1.6 female vs -0.1±1.8 male, p=0.04 for SIS). A SAS-ERS was similar in the domains of tissue handling and coordination. A SAS-ERS did not differ significantly in any domains across levels of training. Expert ratings did not differ significantly by gender for any domain.

CONCLUSIONS: Female surgeons and trainees under rate some technical skills on self-assessment when compared with expert ratings, while male surgeon and trainee self-ratings were concordant with experts. Further work is needed to determine if these differences are accentuated across increasingly difficult tasks.

PD27-03
USE OF MACHINE LEARNING ALGORITHMS TO CLASSIFY SURGICAL MANEUVERS

Brady Miller*, David Azari, Yu H Yu, Robert Radwin, Brian Le, Madison, WI

INTRODUCTION AND OBJECTIVES: Technology allowing automatic interpretation of complex surgical tasks have wide ranging applications in teaching, robotics and cloud-based computing. Computer vision recognition of surgical maneuvers (e.g. suturing, tying, etc.) can expedite video review and objective analysis. Here, we explore how common machine learning techniques can predict surgical maneuvers from a continuous video record of surgical benchtop simulations.

METHODS: Hand movements of 37 clinicians performing simple and running subcuticular suturing benchtop simulations without sensors were recorded via digital video. Three machine learning techniques (decision trees, random forests, and hidden markov models) were selected to classify surgical maneuvers every two seconds (60 frames) of video. Twenty percent of all video segments were randomly selected to serve as a test set for random forest prediction across all tasks, while thirty percent of participants from each experience group (medical students, junior residents, senior residents, attendings) comprised a testing set of twelve participants (ie, participant-controlled). This allowed for both random selection and within-user population accuracy prediction estimates.

RESULTS: Applying the following machine learning techniques, computers were able to accurately classify surgical maneuvers. Random forest predictions of surgical video correctly classified 74% of all video segments into suturing, tying, and transition states for a randomly selected test set. By comparison, decision tree analysis correctly classified 64% of video segments. Hidden markov model adjustments improved the random forest predictions to 79% for simple interrupted suturing on a subset of randomly selected participants.

CONCLUSIONS: Random forest predictions aided by hidden markov modeling provided the best prediction of surgical maneuvers. Marker-less video motion tracking combined with machine learning can accurately predict surgical maneuvers from a continuous video record and may enable more efficient video review of surgical procedures.
PD27-04
DO BRAIN FUNCTION AND EYE GAZE FEATURES BEHAVE DIFFERENTLY BASED ON CATASTROPHIC SURGICAL EVENTS?
Somayeh B. Shafei, Zaeem Lone*, Ahmed S. Elsayed, Naif A. Aldhaam, Buffalo, NY; Zhe Jing, Buffalo, NY; Israh Ibrahim, Khurshid A. Guru, Buffalo, NY

INTRODUCTION AND OBJECTIVES: Electroencephalogram (EEG) and detailed eye tracking in surgeons during complex, catastrophic events of robot-assisted surgery (RAS) is yet to be defined. In this study, we sought to explore the difference between surgeons’ brain activity and eye gaze during RAS while encountering catastrophic intraoperative events (bleeding) and regular surgery.

METHODS: Electroencephalogram (EEG) data (500 Hz) was recorded from 120 areas of the brain of one RAS surgeon while he performed 86 surgeries (three cases of intraoperative bleeding). The participant’s brain network integration and recruitment features were calculated using network neuroscience algorithms. Integration refers to the probability that an area in the brain is in the same network community as areas from other cognitive systems (e.g. the frontal lobe communicates with the occipital lobe). Recruitment is the probability that an area in the brain is in the same network community as other areas from its own cognitive system (e.g. communication within the frontal lobe).

Eye tracking was recorded in 79 cases (2 cases of intraoperative bleeding). Eye tracking data was analyzed for three features: fixation, saccade, and divergence. Fixation is the period in which the surgeon’s eyes are locked toward a specific object. Saccade is the eye tracking movement between fixations and measures attention. Divergence is a feature used to measure focus and is determined by considering the behavior of both eyes and calculating the difference between horizontal locations for each eye and taking the average across all observations within 1s.

RESULTS: EEG data revealed that both Integration and Recruitment were higher in catastrophic than normal events suggesting increased autonomy in brain activity. Eye tracking data revealed that the fixation rate was higher for procedures with bleeding compared to regular cases. The saccade rate was lower for procedures with bleeding compared to regular surgery suggesting increased attention. Divergence was lower in procedures with bleeding suggesting increased focus.

CONCLUSIONS: Brain integration and recruitment features may serve as informative metrics toward an evaluation of a surgeon’s risk management ability. Eye tracking data revealed increased attention and focus during these catastrophic events.

Source of Funding: Society of Academic Urologists

PD27-05
HOW DOES THE BRAIN RESPOND TO GAPS IN PRACTICE SESSIONS DURING TRAINING FOR ROBOT ASSISTED SURGERY?
Somayeh B. Shafei, Zaeem Lone, Ahmed S. Elsayed*, Naif A. Aldhaam, Randy Felber, Sai Jayaprakash, Michael Seggio, Khurshid A. Guru, Buffalo, NY

INTRODUCTION AND OBJECTIVES: Acquiring surgical skills, interacting with the robotic console, and a new surgical environment add to the complexity of the learning process during surgical training. Gaps in practice affect the learning curve. In this study, we investigated the dynamic changes of a trainee’s brain functional states over a training period.

METHODS: Electroencephalography (EEG; 20 channels) data from 27 trainees was recorded over six training sessions over a period of one year. Trainees performed five tasks based on the validated FSRFS- Fundamental Skills of Robotic Surgery (FSRS) curriculum which included Instrument Control Task, Ball Placement Task, Spatial Control II Task, Fourth Arm Tissue Retraction, and the Hands-on Surgical Training (HoST) module. The participants’ brain network integration and recruitment features were calculated using network neuroscience algorithms. Integration is the probability that an area in the brain is in the same network community as areas from other cognitive systems (e.g. the frontal lobe communicates with the occipital lobe). Recruitment is the probability that an area in the brain is in the same network community as other areas from its own cognitive system (e.g. the frontal lobe communicates within itself).

RESULTS: We found correlations between variation in practice sessions gap with integration and recruitment at different frequency bands (Table 1). Longer intervals between practice sessions were associated with lower recruitment of motor, and visual cortices resulting in longer learning processes. A significant negative correlation between network features (strength and communication) and FSRFS metrics on the simulator suggested strength and communication as distinctive features for performance evaluation during robot assisted surgery learning.

CONCLUSIONS: The present study is the first reported study aimed at investigating the brain dynamic changes and the effect of practice gap during robot assisted surgery learning.

**Table 1. Correlation results**

| Source of Funding: This work was supported by the Roswell Park Alliance Foundation. |